

# Emerging contaminants and biological wastewater treatment

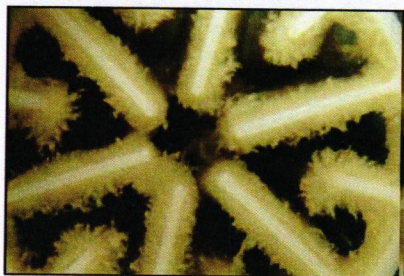
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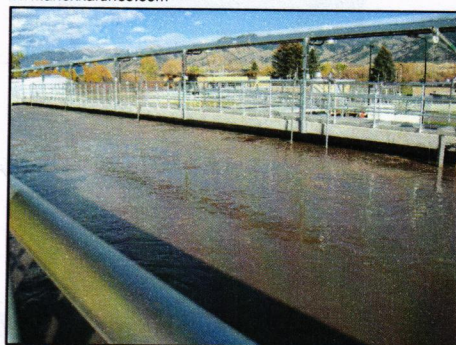


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## Suspended and attached growth wastewater treatment technologies



[www.anoxkaldnes.com](http://www.anoxkaldnes.com)



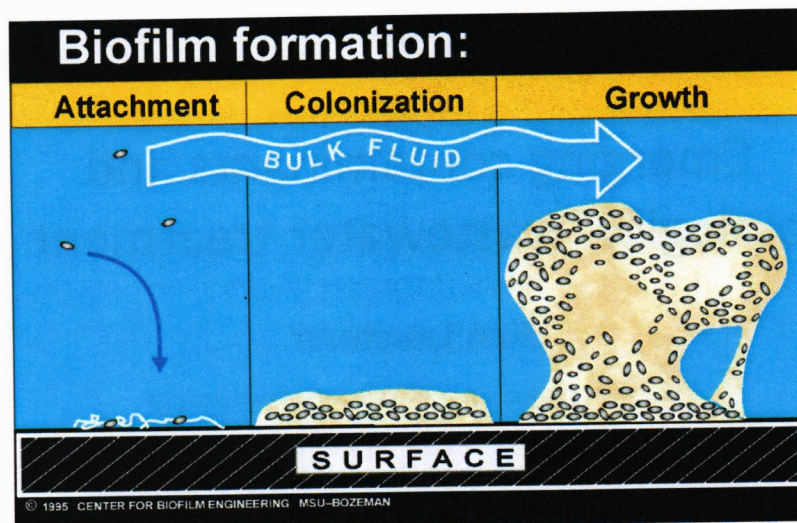
Bozeman Water Reclamation Facility



WATER POLICY INTERIM  
COMMITTEE 2015-16



## Attached growth processes - biofilms in wastewater

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## Need for nitrogen removal from wastewater

## Ecological impacts

- Eutrophication
- Ammonia toxicity on aquatic species

## Human health

- Toxic algal blooms

## Economic impacts

- Treatment of drinking water

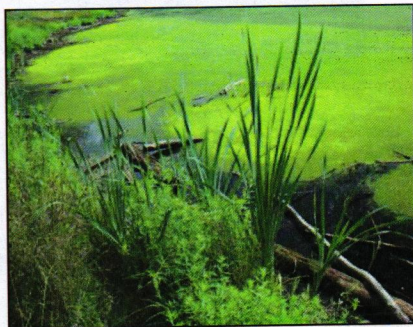
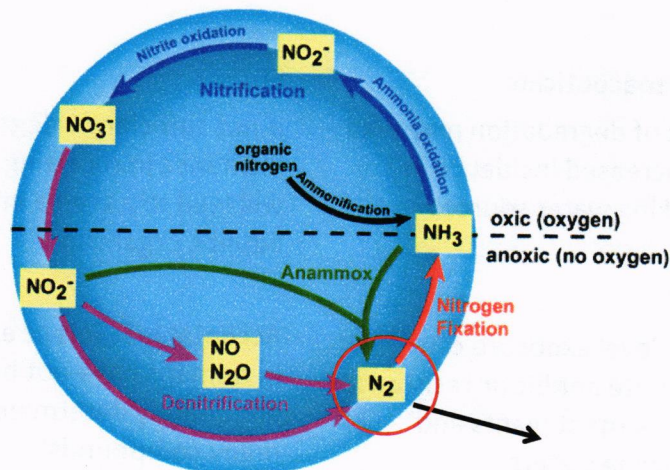


Image source: U.S. EPA

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## Nitrogen Removal in Wastewater Treatment



From Bernhard, A. (2010) The Nitrogen Cycle: Processes, Players, and Human Impact. Nature Education Knowledge 2(2):12



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## Emerging Contaminants

- **Pharmaceuticals and personal care products**
  - Antibiotics, analgesics (e.g. ibuprofen), antidepressants (e.g. fluoxetine = Prozac), carbamazepine (anti-seizure)
  - Chemicals from household products: DEET, fragrances, caffeine, detergents
- **Endocrine disrupting compounds**
  - Steroidal hormones, e.g. estrogen, progesterone



**Currently no wastewater discharge limits or drinking water regulations for PPCPs or EDCs**



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## Ecosystem and health concerns

### Pharmaceuticals

Lack of degradation may lead to increased incidence in drinking water sources

Low-level exposure can promote antibiotic resistance in treatment plants and receiving waters

### EDCs

If not sufficiently degraded, incidence in receiving waters will lead to adverse impacts on aquatic organisms

Acceptable levels of exposure in humans have not been adequately determined for many compounds



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## Pharmaceuticals and EDCs in wastewater

### Current challenges:

1. Biodegradability and fate in treatment processes (Alvarino, et al., 2014; Luo, et al. 2014; Ahmed, et al., 2016)
  - Is the contaminant degraded biologically and what are the products?
  - Advanced oxidation processes for degradation: ozonation, photolysis and other chemical methods
2. Impact of contaminants on efficiency of treatment (Schmidt, et al. 2012; Campos, et al. 2001)
  - Does the presence of the contaminant impact microbial processes such as organic carbon and nitrogen removal?



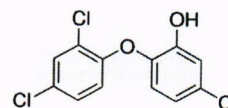
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## Emerging Contaminant of Interest

### Triclosan (TCS)



#### • Occurrence:

- Present in multitude of personal care products
- Found in 58% of surveyed streams

#### • Effects:

- Broad spectrum antimicrobial agent
- Can behave as a thyroid disruptor in humans
- Impacts on WW bacteria are largely unknown



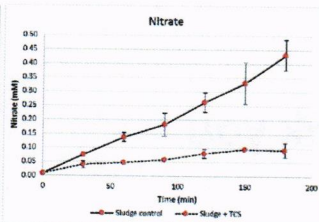
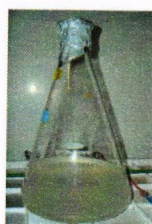
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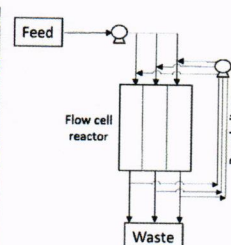
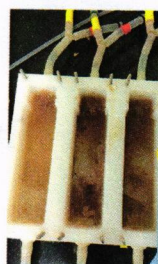
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## Triclosan impact on nitrification

### Suspended bacteria



### Biofilms



Nitrifying activity in activated sludge and biofilms monitored during triclosan exposure

- Nitrifying bacteria are inhibited by high concentrations of triclosan, potential implications for nitrification in WWTP
- Future work: long-term exposure

Kylie Bodle, EENV M.S. student



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## Thank you



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## Emerging Contaminants in Gallatin County

### Assessment of EDCs and pharmaceuticals in Gallatin County

- Wastewater treatment systems, septic, surface and groundwater
- Measured compounds from pharmaceuticals, EDCs and personal care products

### Selected study results

- Most compounds were reduced from influent to effluent of WWTPs
- Degradation decreased in winter months compared to summer
- At least one compound was detected in almost all stream locations and 87% of wells sampled

Assessment and Distribution of Pharmaceuticals and Endocrine Disruptors in Wastewater, Ground Water and Surface Waters of the Gallatin Valley, Gallatin County, Montana

### FINAL REPORT

Grant Agreement RIT-08-8685

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